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[Title of the Invention]

EXTERNAL ELECTRODE TYPE FLUORESCENT TUBE

[Abstract] (amended)

[Problem]

To provide an external electrode type fluorescent tube having a structure in which stable visible and/or ultraviolet light can be obtained.

[Construction]

A linear or strip-shaped, first electrode 6 is provided to extend along a bulb-axis direction of an external surface of a bulb 1 and a pair of linear or strip-shaped second electrodes 7 and 8 are respectively provided on the external surface of the bulb at positions equidistant from the first electrode so as to respectively extend along the bulb-axis direction on both sides of the first electrode.

[Claims]

[Claim 1]

An external electrode type fluorescent discharge tube in which an inside of a tubular bulb is hermetically filled with at least one kind of rare gas such as Ne, Ne, Ar, Xe and Kr by a predetermined amount and an inside surface of the bulb is coated with a fluorescent material, characterized in that a linear or strip-shaped, first electrode is provided to extend along a bulb-axis direction of an external surface of the bulb and this electrode is covered with an insulator, and a pair of linear or strip-shaped electrodes are respectively provided on the external surface of the bulb at positions equidistant from the first electrode so as to respectively extend along the bulb-axis direction on both sides of the first electrode.

[Claim 2]

An external electrode type fluorescent discharge tube according to claim 1, characterized in that a high frequency voltage to be applied to the first and second electrodes is supplied from a power source including a step-up transformer and a high frequency oscillator made of a transistor, a field effect transistor or the like.

[Claim 3]

An external electrode type fluorescent discharge tube according to claim 2, characterized in that electrical circuit devices such as a capacitor and a resistor are connected to

an output side of the high frequency power source.

[Claim 4]

An external electrode type fluorescent discharge tube according to claims 1 to 3, characterized in that mercury vapor is sealed in an inside of the bulb.

[Claim 5]

An external electrode type fluorescent discharge tube according to claims 1 to 4, characterized in that the fluorescent material on the inside surface of the bulb positioned between edges of the pair of second electrodes on mutually opposed sides is removed and an aperture is provided.

[Detailed Description of the Invention]

[0001]

[Industrial Field]

This invention relates to an external electrode type fluorescent discharge tube (hereinafter referred to as a fluorescent lamp or simply a lamp) for use in document illumination used in information equipment such as facsimile machines, copying machines and image readers, and for use in backlight units for liquid crystal display panels and the like.

[0002]

[Prior Art]

Fluorescent lamps of the type in which discharge is maintained by a pair of external electrodes formed on an outside wall of a bulb are used in light sources for OA equipment,

backlights for display devices and the like. Referring to the drawings, Fig. 1 is an explanatory view of a lamp and a power source, and Fig. 2 is an explanatory view of a A-A cross section of the lamp. A pair of external electrodes 2 and 3 are provided on an external surface of a bulb 1 hermetically closed at both ends 100 and 101 in such a manner as to be spaced apart from each other in the circumferential direction. These external electrodes 2 and 3 are connected to a high frequency power source 4. Each of these external electrodes 2 and 3 is formed of metal tape such as aluminum tape or copper tape or an electrically conductive coating such as silver paste, so as to extend in a strip-like shape along the axial direction of the bulb. An inside surface of the bulb 1 is coated with a fluorescent material 5. The bulb may be filled with only a rare gas such as xenon, or may also be filled with a predetermined amount of mercury and a rare gas.

[0003]

In such a lamp, when a high frequency current flows between the external electrodes 2 and 3 from the high frequency power source 4, discharge 10 is performed in the bulb 1 and a rare gas or mercury is excited to emit ultraviolet rays, and these ultraviolet rays are converted to visible light by the fluorescent material 5 and emitted to the outside.

[0004]

[Problems that the Invention is to Solve]

However, there is a case where the high frequency current between the external electrodes 2 and 3 is affected by the nonuniformity of the contact between glass and the external electrodes, the nonuniformity of glass wall thickness, small variations in the high frequency current, and the like, so that the discharge 10 appears in a striped pattern along the effective emission surface 9 and is brought into an unstable state. Particularly as the high frequency current becomes smaller, this phenomenon appears more remarkably. This unstable discharge 10 also affects visible light emitted from the fluorescent material 5, and similarly, visible light emitted from the effective emission surface 9 assumes a striped pattern and becomes unstable.

[0005]

If the fluorescent lamp is used for document illumination in information equipment such as facsimile machines, copying machines and image readers, such phenomenon causes the problem that information cannot be accurately transmitted, while if the fluorescent lamp is used in a backlight unit for liquid crystal display panels, the phenomenon causes problems such as flickers or jitters.

[0006]

The invention has been made in view of the above-mentioned problems, and an object of the invention is to provide an external electrode type fluorescent discharge tube having

an external electrode type structure in which stable visible and/or ultraviolet light can be obtained.

[0007]

[Means for Solving the Problem]

An object of the invention is achieved by providing an external electrode type fluorescent discharge tube in which a linear or strip-shaped, first electrode is provided to extend along a bulb-axis direction of an external surface of a tubular bulb and a pair of linear or strip-shaped electrodes are respectively provided on the external surface of the bulb at positions equidistant from the first electrode so as to respectively extend along the bulb-axis direction on both sides of the first electrode.

[0008]

[Function]

According to the invention, because a high frequency current stably flows, visible light can be stably emitted from a fluorescent lamp, and far more stable visible light can be obtained by adjusting electrical characteristics such as a capacitance between a high voltage side and a ground voltage side.

[0009]

[Embodiment]

One embodiment of the invention will be described below with reference to the accompanying drawings. Fig. 3 is an

explanatory view of a lamp and a power source according to the invention, and Fig. 4 is an explanatory view of an A-A cross section of the lamp according to the invention. In Figs. 3 and 4, reference numeral 1 denotes a bulb closed at opposite ends 100 and 101. The inside surface of the bulb 1 is coated with a fluorescent material, and the fluorescent material on the inside surface of the bulb located between mutually opposed edges 102 and 103 of second electrodes 7 and 8 is removed and an aperture 13 is provided in place of the removed fluorescent material. A first electrode 6 is a strip-shaped electrode which is provided to extend along the bulb-axis direction of the bulb 1, and a pair of second electrodes 7 and 8 are a pair of strip-shaped electrodes provided on an external surface of the bulb so as to respectively extend along the bulb-axis direction thereof on both sides of the first electrode 6, and are respectively provided at positions equidistant from the electrode 6. Each of the electrodes 6, 7 and 8 is formed of metal tape such as aluminum tape or copper tape or an electrically conductive coating such as silver paste. The edge 102 of the second electrode 7 and the edge 103 of the electrode 8 are preferably disposed to extend along edges 104 of the opening angle of the aperture 13 determined by the removal of the fluorescent material. In addition, an effective emission surface 9 is disposed in the forward direction of the electrode 6.

[0010]

In the case of this arrangement, when a high frequency current flows from the high frequency power source 4 to the second electrodes 7 and 8 via the first electrode 6, for example, a high frequency current which flows from the electrode 6 flows to the pair of electrodes 7 and 8 which are provided at the right and left equidistant positions of the bulb 1 as viewed from the electrode 6, and a flow path in which the high frequency current flows at this time is divided into the right and the left from the electrode 6, whereby the high frequency current passes through discharge paths 11 and 12, and flows to the electrodes 7 and 8.

[0011]

The lamp which discharges in this manner can emit stable visible light because a striped-pattern section in which discharge is unstable is nearly invisible from the effective emission surface 9. In addition, it is possible to obtain far more stable discharge by setting electrical circuit devices, for example, a capacitor 14 and a resistor 15 to arbitrary values and providing the capacitor 14 and the resistor 15 between the first electrode 6 and each of the electrodes 7 and 8 as shown in Fig. 3, whereby it is possible to obtain discharge which is stable to such an extent that a striped pattern of discharge is completely invisible from any angle. Namely, electrical circuit devices such as a capacitor and a resistor

may be provided on an output side of the high frequency power source as required.

[0012]

Fig. 5 shows a luminance stability characteristic chart of the effective emission surface 9 of a fluorescent lamp which is lit by the conventional discharge system shown in Fig. 1, and Fig. 6 shows a luminance stability characteristic chart of the effective emission surface of a fluorescent lamp which is lit by the present inventive discharge system shown in Fig. 3. From a comparison between the characteristic charts of Figs. 5 and 6, it can be seen that in the conventional discharge system, a light ripple in light measurement occurs by approximately ±6%, while in the present inventive discharge system, a light ripple in light measurement is nearly 0%.

[0013]

[Advantage of the Invention]

As described hereinabove, according to the invention, it is possible to emit extremely stable visible light and/or ultraviolet light, and it is possible to provide stable light in the case of document illumination used in information equipment and in backlight units for liquid crystal panels and the like.

[Brief Description of the Drawings]

[Fig. 1] An explanatory view of a conventional fluorescent lamp and power source.

[Fig. 2] An explanatory view of an A-A cross section of the fluorescent lamp.

[Fig. 3] An explanatory view of a fluorescent lamp and a power source according to the invention.

[Fig. 4] An explanatory view of an A-A cross section of the fluorescent lamp according to the invention.

[Fig. 5] A luminance stability characteristic chart of the conventional fluorescent lamp and power source.

[Fig. 6] A luminance stability characteristic chart of the fluorescent lamp and the power source according to the invention.

[Description of Reference Numerals and Signs]

1	tubular bulb
2, 3	external electrode
4	high frequency power source
5	fluorescent material
6	first electrode
7, 8	second electrode
9	effective emission surface
13	aperture

Fig. 5, Fig. 6

LUMINANCE (RELATIVE VALUE)

TIME